IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	William G. America, et al.	**Examiner:**	Jack S. J. Chen
Serial No:	10/674,646	**Art Unit:**	2813
Filed:	September 30, 2003	**Docket:**	YOR920030320US1 (16868)
For:	PLASMA SURFACE MODIFICATION AND PASSIVATION OF ORGANO-SILICATE GLASS FILMS FOR IMPROVED HARDMASK ADHESION AND OPTIMAL RIE PROCESSING		

Confirmation No. 4797

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION PURSUANT TO 37 C.F.R. §1.131

Sir:

We, William G. America, Timothy J. Dalton, Kaushik A. Kumar and Heidi L. Wickland, hereby declare that:

1. We are co-inventors of the subject matter described and claimed in the above-identified patent application.

2. Prior to December 12, 2002, which is the effective filing date of U.S. Patent No. 6,720,255 B1 to Faust et al. ("Faust et al."), we have conceived and reduced to practice a semiconductor structure such as, an interconnect structure, that comprises one or more interconnect levels, one on top of each other, each level comprising an organo-silicate glass (OSG) dielectric material having a plasma treated surface layer that provides improved adhesion to an overlying lower hardmask, yet is substantially undamaged, as is recited in Claim 1 of the present application.

3. As evidence of the conception and reduction to practice of the claimed semiconductor structure referred to in paragraph 2 prior to the effective filing date of Faust et al., annexed hereto is Exhibit A. Exhibit A is a true reprint in PDF format of IBM Invention Disclosure YOR820030277, which was created prior to December 12, 2002. Exhibit A includes

a Main Idea section for the Invention Disclosure which describes the fabrication of a semiconductor structure such as an interconnect structure that is recited in Claim 1 of the present application. This write-up provides greater detail of the invention presently claimed including experimental data that establishes clear evidence of actual fabrication of the claimed semiconductor structure. All names and dates have been redacted in the preparation of this Declaration.

4. We do hereby declare that all statements made herein of our own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements may jeopardize the validity or enforceability of the patent.

30 May 2007
Dated

William G. America

Dated

Timothy J. Dalton

Dated

Kaushik A. Kumar

Dated

Heidi L. Wickland

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Dated 5/24/07	William G. America
Dated	Timothy J. Dalton
Dated	Kaushik A. Kumar
Dated	Heidi L. Wickland

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Dated	William G. America
Dated	Timothy J. Dalton
6/14/07	
Dated	Kaushik A. Kumar
Dated	Heidi L. Wickland

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Dated	William G. America
Dated	Timothy J. Dalton
Dated	Kaushik A. Kumar
6/13/07 Dated	Heidi L. Wickland

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Exhibit A

Disclosure YOR8-2003-0277

Prepared for and/or by an IBM Attorney - IBM Confidential

***Title of disclosure (in English)**

Plasma surface modification and passivation of porous organo-silicate glass (p-OSG) films for improved hardmask adhesion and optimal RIE processing

Summary

Status	Final Decision **(File)**
Docket Family	YOR9-2003-0320
*Processing Location	YOR
*Functional Area	(703B) 703B INTERCONNECT TECHNOLOGY
Attorney/Patent Professio	
IDT 1	
Submitted Date	
*Owning Division	RES
Lab	
*Technology Code	1011

Inventors with a Blue Pages entry

Inventors without a Blue Pages entry

IDT Selection

***Main Idea**

1. Describe your invention, stating the problem solved (if appropriate), and indicating the advantages of using the invention.

2. How does the invention solve the problem or achieve an advantage,(a description of "the invention", including figures inline as appropriate)?

3. If the same advantage or problem has been identified by others (inside/outside IBM), how have those others solved it and does your solution differ and why is it better?

4. If the invention is implemented in a product or prototype, include technical details, purpose, disclosure details to others and the date of that implementation.

***Critical Questions (Questions 1-9 must be answered in English)**

***Question 1**
On what date was the invention workable? **Please format the date as MM/DD/YYYY**
(Workable means i.e. when you know that your design will solve the problem)

***Question 2** ○ Yes ● No
Is there any planned or actual publication or disclosure of your invention to anyone outside IBM?

If yes, Enter the name of each publication or patent and the date published below.
Publication/Patent:
Date Published or Issued:

Are you aware of any publications, products or patents that relate to this invention? ○ Yes ● No

If yes, Enter the name of each publication or patent and the date published below.
Publication/Patent:
Date Published or Issued:

***Question 3** ○ Yes ● No
Has the subject matter of the invention or a product incorporating the invention been sold, used internally in manufacturing, announced for sale, or included in a proposal?

Is a sale, use in manufacturing, product announcement, or proposal planned? ○ Yes ● No

If Yes, identify the product if known and indicate the date or planned date of sale, announcements, or proposal and to whom the sale, announcement or proposal has been or will be made.
Product:
Version/Release:
Code Name:

Date:
To Whom:
If more than one, use cut and paste and append as necessary in the field provided.

***Question 4** ○ Yes ● No
Was the subject matter of your invention or a product incorporating your invention used in public, e.g., outside IBM or in the presence of non-IBMers?
If yes, give a date. **Please format the date as MM/DD/YYYY**

***Question 5** ○ Yes ● No
Have you ever discussed your invention with others not employed at IBM?
If yes, identify individuals and date discussed. Fill in the text area with the following information, the names of the individuals, the employer, date discussed, under CDA, and CDA #.

***Question 6** ○ Yes ● No ○ Not sure
Was the invention, in any way, started or developed under a government contract or project?
If Yes, enter the contract number

***Question 7** ○ Yes ● No ○ Not Sure
Was the invention made in the course of any alliance, joint development or other contract activities?
If **Yes**, enter the following:

	Name of Alliance, Contractor or Joint Developer
	Contract ID number
	Relationship contact name
	Relationship contact E-mail
	Relationship contact phone

***Question 8** ○ Yes ● No
Have you, or any of the other inventors, submitted this same invention disclosure or similar invention disclosure previously?
If Yes, please provide disclosure number below:

***Question 9** ○ Yes ● No
Are you, or any of the other inventors, aware of any related inventions disclosures submitted by anyone in IBM previously?
If Yes, please provide the docket or disclosure number or any other identifying information below:

Question 10
What type of companies do you expect to compete with inventions of this type? *Check all that apply.*

- ☐ Manufacturers of enterprise servers
- ☐ Manufacturers of entry servers
- ☐ Manufacturers of workstations
- ☐ Manufacturers of PC's
- ☐ Non-computer manufacturers
- ☐ Developers of operating systems
- ☐ Developers of networking software
- ☐ Developers of application software
- ☐ Integrated solution providers
- ☐ Service providers
- ☒ Other (Please specify below)

Microelectronics companies

Question 11
If the invention relates to a product or service that is outside the scope of your business unit, please recommend IBM business unit(s), IBM location(s) or individual(s) within IBM that you think would provide a good evaluation of your invention:

***Patent Value Tool (Optional - this may be used by the inventor and attorney to assist...**

(The Patent Value tool can be used by the inventor(s) to determine the potential licensing value of your invention.)
Market
***Question 1:** What is the anticipated annual market size (in dollars) that will be captured by your invention?
$10M to $100M
Reason(s) for above Answer:

Claims
***Question 1:** How new is the technical field?
Emerging
Reason(s) for above Answer:

***Question 2:** How central is the invention to the product(s) which might be expected to contain the invention?
Essential
Reason(s) for above Answer:

***Question 3:** What is the scope of the claim?
Moderate
Reason(s) for above Answer:

Portfolio Need
***Question 1:** What are the portfolio needs in the area of your invention?
Listed in PPM Needs
Reason(s) for above Answer:

Exploitation & Enforcement

***Question 1:** How easily can the use of the invention by a competitor be detected?
With work
Reason(s) for above Answer:

***Question 2:** How easily can the use of the invention be avoided by a competitor?
With work
Reason(s) for above Answer:

Business Value
***Question 1:** What percentage of the companies producing products in the field of this invention might use this invention?
By 10% to 30%
Reason(s) for above Answer:

***Question 2:** What is the value of this patent to current or anticipated Alliance Activity between IBM and other companies?
High value
Reason(s) for above Answer:

***Question 3:** What is the value of this patent to current or anticipated Technology Transfer Activity between IBM and other companies?
High value
Reason(s) for above Answer:

***Question 4:** Does it result in prestige to IBM?
External
Reason(s) for above Answer:

Evaluation

Final Evaluation History	Who made the final evaluation	Final evaluation date

Final Decision

This decision was entered by

Decision: File	Status: N/A
PPM Area: 100	Attorney Rating:
Actual Release Date:	
Date of Final Decision	

Additional filing information

Planned Filing date:

Filing comments:

Additional decision comments

Final Decison History

Post Disclosure Text & Drawings

To add additional information related to this disclosure once it has been submitted, click the action button below and a new document will be opened for you to enter the new information. To view existing post disclosure information, double-click on the item in the list below (if there has been additional information entered), and the document will open for you to view.

Date entered	Post disclosure comments and drawings (double-click an item below to view

(Form Revised 12/17/97)

Main Idea for Disclosure YOR8-2003-0277

Prepared for and/or by an IBM Attorney – IBM Confidential

Title of disclosure (in English)

Plasma surface modification and passivation of porous organo-silicate glass (p-OSG) films for improved hardmask adhesion and optimal RIE processing

Idea of disclosure

1. Describe your invention, stating the problem solved (if appropriate), and indicating the advantages of using the invention.

When depositing CVD RIE hardmasks onto organosilicate (OSG) and porous organosilicate (p-OSG) dielectrics, adhesion is a significant issue. Insufficient adhesion of the hardmask will lead to delamination in CMP. This method of fabricating hardmask stack on p-OSG films alleviates the issues posed by adhesion of hardmask stack to the p-OSG film by incorporating an in-situ plasma treatment of the p-OSG dielectric prior to CVD hardmask deposition.

Additionally, CVD hardmasks such as SiC usually need a plasma densification process to prevent moisture absorption when the film is exposed to atmosphere prior to the next processing step. This densification layer has been found to cause micromasking during RIE processing. This proposal describes the deposition of another in-situ hardmask layer (SiN) to eliminate the need for densification of the first hardmask layer, thereby avoiding moisture absorption and avoiding subsequent RIE micromasking problems.

The surface modification of the p-OSG film and the deposition of subsequent hardmask layers (SiC and SiN, or other appropriate films), proposed in this invention, is done in-situ in a single deposition chamber.

2. How does the invention solve the problem or achieve an advantage,(a description of "the invention", including figures inline as appropriate)?

Hardmask stack:

Typical p-OSG film is capped by a SiC film which serves as a CMP stop layer. Typically, the top surface of this SiC film is densified in order to minimize the uptake of moisture by SiC. In order to protect the SiC film film from the oxygen-plasma based photoresist-strip process, a thin capping layer of SiN is used.

Issues with the fabrication sequence:

1. Untreated p-OSG film surface results in poor adhesion with the SiC capping layer.
2. SiC film is typically modified by He plasma treatment, which leads to a densification of the SiC surface. Densification of the SiC surface leads to micromasking in the trough-open step of the dual-damascene RIE process.
3. The SiC film is capped by SiN layer to protect the SiC layer from photoresist rework. The rework process involves an oxygen-plasma, which also etches the SiC film layer.

Solution proposed:
The p-OSG film is subjected to a brief He or other appropriate gas, plasma which modifies the film surface. This modified film surface ensures good adhesion with the SiC film layer. In order to preserve the modified p-OSG film surface, SiC is deposited in-situ on the surface-modified p-OSG film. The deposition of the SiC film is followed by the deposition of SiN film, in-situ, in order to prevent moisture uptake by the SiC film. This method eliminates the necessity of the densification of the SiC film. An example is:

p-OSG film -> He plasma treatment -> in-situ deposition of SiC film -> in-situ deposition of SiN film

Thus, a hardmask fabrication scheme is proposed that ensures good adhesion with the p-OSG film and also provides a simplified solution to the micromasking profile obtained during the trough-etch.

Novel HM process for RIE.PF

3. If the same advantage or problem has been identified by others (inside/outside IBM), how have those others solved it and does your solution differ and why is it better?

Identification of the problem:
1. He plasma treatment is known and has been implemented in the SiLK/SiCOH dual-damascene build in order to promote wetting and adhesion of SiLK on methylsilicones including CORAL and other similar films.
2. Less densified SiC film has been capped by N-doped SiC film, in order to prevent micromasking during trough-open. This has been implemented in the SiLK/USG dual-Damascene build. Unfortunately, this leads to a more complicated hardmask stack and SiC densification is not completely eliminated.

Difference in our solution:
The deposition of the SiC film occurs in-situ on the p-OSG film, resulting in a clean interface. SiN is deposited in-situ on SiC, resulting in the elimination of the N-doped SiC film while maintaining the integrity of the hardmask stack towards RIE and CMP processes. RIE and CMP processes do not have to address the non-uniformity of composition during processing that would result in differences in the rate and or final thicknesses of the films involved.

4. If the invention is implemented in a product or prototype, include technical details, purpose, disclosure details to others and the date of that implementation.

NO